Structure-Preserving Numerical Methods for Nonlinear Dispersive Wave Equations

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We use the general framework of summation by parts operators to construct conservative, entropy-stable and well-balanced semidiscretizations of two different nonlinear systems of dispersive shallow water equations with varying bathymetry: A variant of the coupled Benjamin-Bona-Mahony (BBM) equations and a recently proposed model by Svärd and Kalisch (2023) with enhanced dispersive behavior. Both models share the property of being conservative in terms of a nonlinear invariant. This property is preserved exactly in our novel semidiscretizations. To obtain fully-discrete entropy-stable schemes, we employ the relaxation method. We present the improved numerical properties of our schemes in various test cases.